Space Weather Technical Forecast

Issued on Saturday 2 November 2024 at 13:19 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Moderate to High solar activity with M-flares expected, and a chance of X-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity was moderate with four M-flares, the largest of which was a M2.0 at 01/1431 UTC from AR3878 in the northeast. There are fourteen active regions, with two as yet unnumbered regions. AR3878 remains the most active flare source with two delta spots visible within its larger trailer. AR3869 remains the most complex and active region within the cluster of spots in the southwest, with AR3871 to the NW of this also showing some complexity and recent flare activity. Most other sunspots only showing slow evolution currently.

No Earth-directed CMEs were observed in available imagery.

Solar Wind / Geomagnetic Activity: Solar winds as measured at L1 by ACE/DSCOVR were initially at slightly elevated levels, falling to background between 01/2000-02/0100UTC. Winds have generally remained slightly elevated since then, but have seen a recent rise due to a possible transient arrival, reaching a brief peak of 508km/s, but have since fallen to around 420-450km/s. Density was below average throughout. The Interplanetary Magnetic Field (IMF), Bt, was weak to moderate 6-12nT, peaking later in the period following transient arrival. The north-south component, Bz, was mostly weak and positive, but did become more persistently negative from around 02/0600UTC, reaching -12nT. Phi angle was predominantly negative (towards the Sun). Geomagnetic activity was Quiet to Active (Kp0-4).

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 was at S1 Minor Radiation Storm to start, falling below the S1 threshold at 01/0855 UTC and falling to 4pfu by 02/0000 UTC. High energy electron flux (greater than 2MeV) observed by GOES16 was Background to Moderate. The associated 24-hour fluence was well below the Active threshold, with 4.68e6 integrated flux observed at 02/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate or High activity is expected to continue into the start of the period, with occasional M-class flares expected and a chance of further isolated X-class flares. Into days 3-4 (04-05 Nov) flare risk perhaps reducing somewhat as active regions in the west begin to rotate off the visible disk.

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Solar Wind / Geomagnetic Activity: A CME which left the sun during the 31st Nov has the potential to give a glancing blow to Earth late on day 2 (03 Nov) or into early day 3 (04 Nov). Quiet to Unsettled geomagnetic activity is expected initially, with a chance of isolated Active intervals due to current enhancements. Activity expected to increase to become more generally Unsettled into day 2 (03 Nov) and day 3 (04 Nov), with a chance of Active and a slight chance of G1/Geomagnetic Storm intervals given the risk of a glancing CME blow and HSS influence. Activity currently expected to be generally Quiet to Unsettled once again by day 4 (05 Nov).

Energetic Particles / Solar Radiation: The high energy proton flux at GOES-18 is now below the S1 Moderate Radiation Storm level, and continuing to slowly decline. However, any further notable flares bring a persistent chance for further enhancement during the period. The high energy electron flux is expected to be Background to Moderate, with the associated fluence forecast to persist below Active levels.

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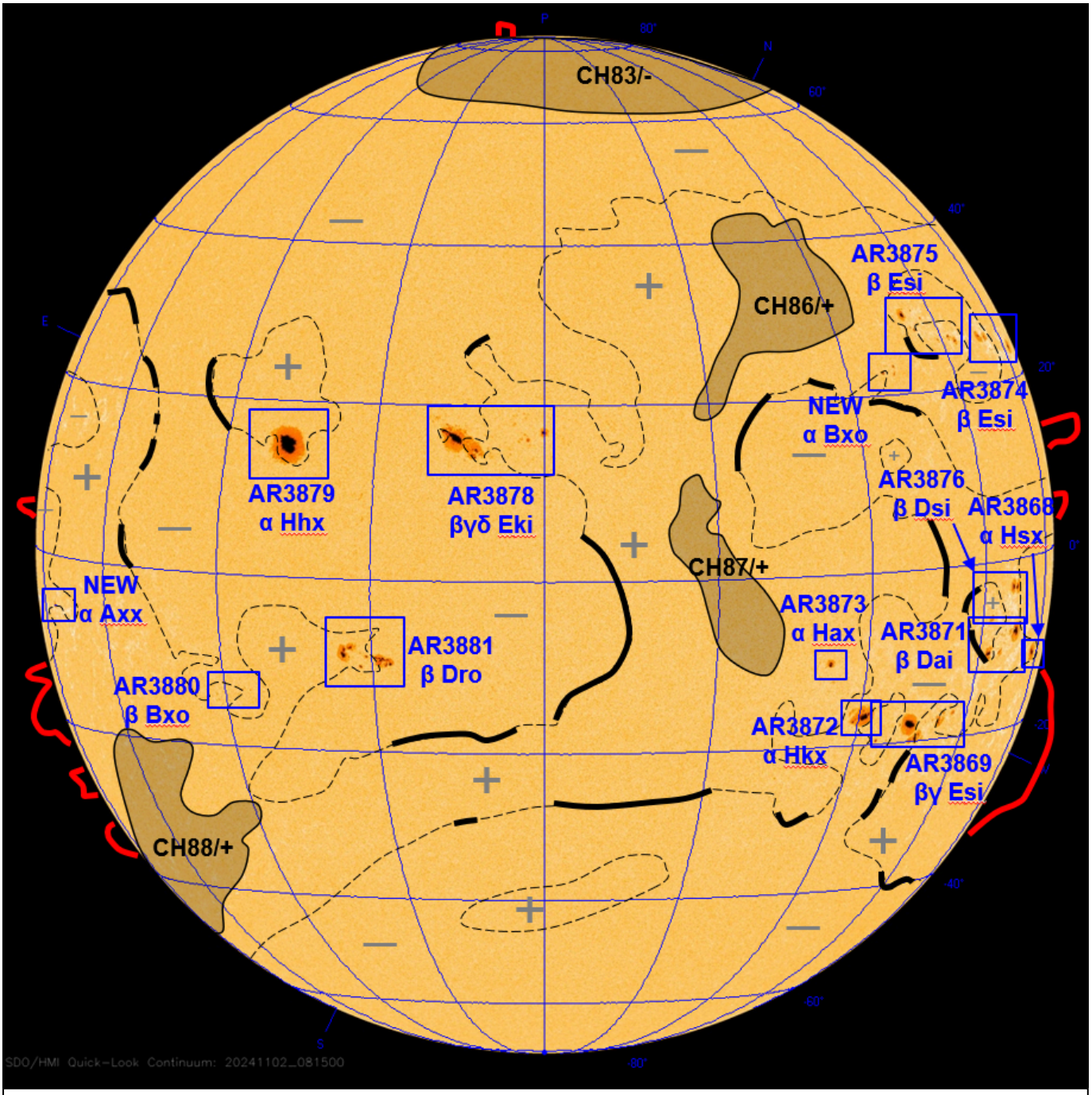
Figure 1: Solar Synoptic Map valid 02/0800UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

A CME which left the Sun during the 31st Nov has the potential to give a glancing blow to Earth late on day 2 (03 Nov) or into early day 3 (04 Nov). This is low confidence however given a lack of imagery for analysis. These recent gaps in available coronagraph imagery, combined with the number of large filaments on the Earth-facing disc and the continued chance for notable flares, results in a CME forecast which has a greater than usual potential to change at short notice in the coming days.

The Earth is experiencing some weak enhancement, likely as a result of another transient CME influence, with winds rising to slightly elevated levels. Into the period influence from CH86/+, or more likely CH87/+ to its south, may cause further enhancement to slightly elevated or perhaps elevated levels through the latter part of day 2 (02 Nov) or more likely into day 3 (04 Nov) . While these features are recurrent ones, both appear larger and more prominent on this rotation, which suggests that the current solar wind increase might be underestimated by the MOSWOC ENLIL model.

Quiet to Unsettled geomagnetic activity is expected initially due to ongoing weak CME influence, with a chance of Active intervals. Activity expected to increase to become more generally Unsettled into day 2 (03 Nov) and day 3 (04 Nov), with a chance of Active and a slight chance of G1/Geomagnetic Storm intervals given the risk of a glancing CME blow and HSS influence. Activity currently expected to be generally Quiet to Unsettled once again by day 4 (05 Nov) although forecast lower than usual confidence.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	**G1 to G2**	No	10	20	20	10
Strong	**G3**	No	1	1	1	1
Severe	**G4**	No	1	1	1	1
Extreme	**G5**	No	1	1	1	1

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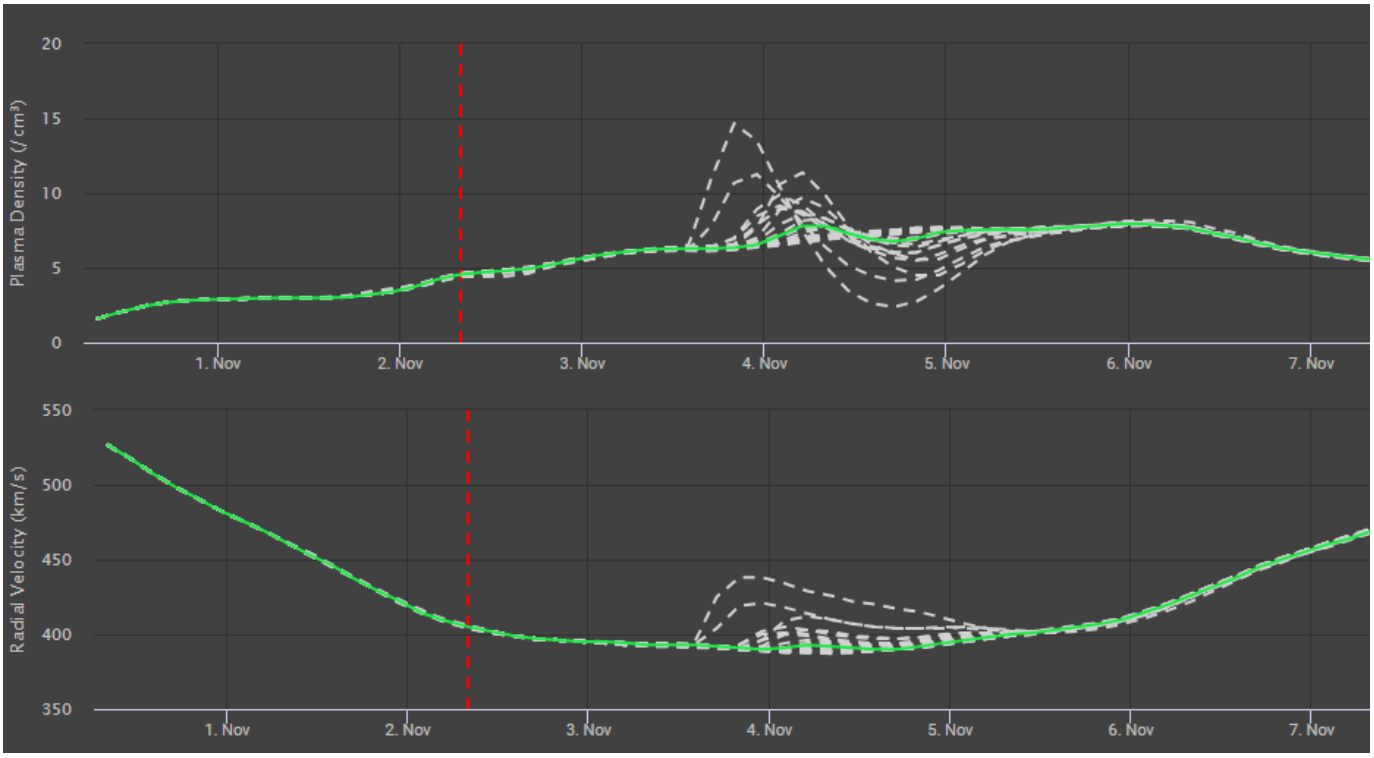
Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
31/1915	Partial	AR3877	central-southern disk	600	04/0300 +-6hr	Low confidence, glancing blow.

Figure 2: MOSWOC Ensemble output. Glancing CME blow suggested for late day 3 into day 4 (03-04 Nov). The more general increase in wind speeds later in the period thought likely to be somewhat late, and not accurately representative of CH86/87.



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Radio Blackouts - X-Ray Flares

The visible disk remains highly populated with fourteen active sunspot regions, two as yet unnumbered, one in the NW and the other close to the E limb. AR3878 in the NE, and the cluster of spots in the SW, remain the most active flare source regions. AR3878 still has two delta spots visible within its larger trailer portion and remains statistically the most likely flare source, with this region responsible for two X-class flares in recent days. AR3869 remains the most magnetically complex region within the cluster of spots in the southwest, with opposite polarity to what would be expected for a southern disc sunspot ("anti-Hale"), although the magnetic demarcation between this spot and sounding regions is somewhat unclear, AR3871 to the NW of this region also seeing some complexity and recent flare activity. These regions will be approaching the western limb by the end of the period. There remains other notable regions as well, with the two sunspots in the northwest, AR3874 and particularly AR3875, both presenting an ongoing risk of flares, with AR3874 also due to leave the visible disk later in the period. Most other sunspots only showing slow evolution, however confidence in the evolution of all spot regions over the past 12 hours is low however due to missing SDO imagery.

Moderate or High activity is expected to continue initially, with occasional M-class flares expected and a chance of further isolated X-class flares. By day 3 (04 Nov) and into day 4 (05 Nov) regions leaving the western limb may see a slight decrease in the total flare risk, with recurrence and far-side sounding imagery not suggesting any significant oncoming regions. Therefore the flare risk reducing slightly into the period, although Moderate activity remains likely pending further developments.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	80	80	70	70
Very Active	R3-R5 (X Class)	No	25	25	20	20

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Figure 3: GOES-16 & -18 X-ray flux for past 24hrs

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Solar Radiation Storms (High Energy Protons)

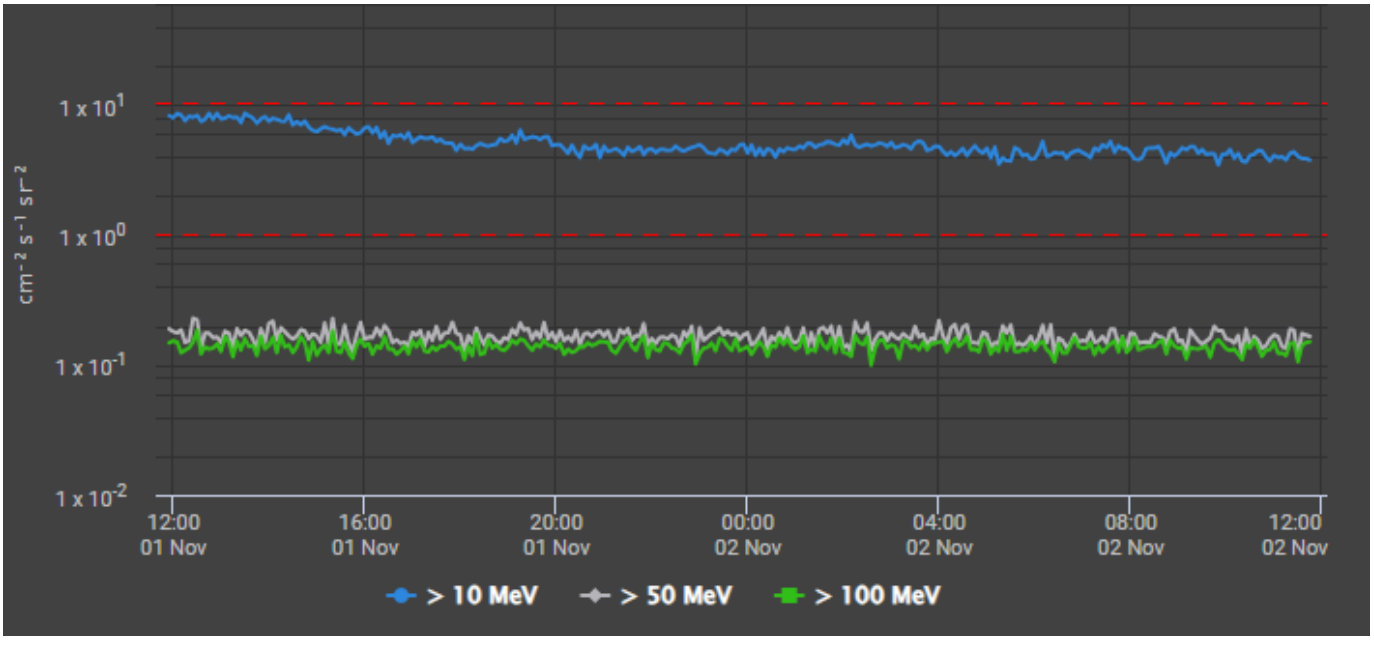
The recently elevated high energy proton flux at GOES-18 over previous days has now fallen below the S1 Minor Radiation storm level and is expected to decline towards background through days 1 and 2 (02-03 Nov) in the absence of further enhancement.

Further enhancements remain possible however, with the potential for notable flares from a number of the sunspots on the disc. This includes the cluster of regions in the western disc, all of which will remain in potentially geo-effective positions through the period even as some spots round the western limb. The proton risk associated with AR3878 will also only increase into the period as this region transits west, although only limited proton response has been diagnosed from the recent significant flares from this region.

Overall there is a persistent chance of further proton enhancement though the period, reducing slightly through the latter half as conditions likely continue to ease in the absence of further enhancement.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	30	30	25	25
Very Active	**≥ S3 ***	No	5	5	5	5
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: GOES-18 Proton flux from past 24 hrs.



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High Energy Electrons (≥ 2MeV)

High energy electron flux (greater than 2MeV) as observed by GOES16 is currently at background and expected to persist mostly at this level, with only brief spells of moderate enhancement expected.

The associated 24-hour fluence is currently expected to remain well below Active throughout the period, with the MOSWOC REFM forecast though to be providing reasonable guidance.

GEO Electron Environment Probability (Exceedance)	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ 1×10^{8}**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ 1×10^{9}**	No	1	1	1	1

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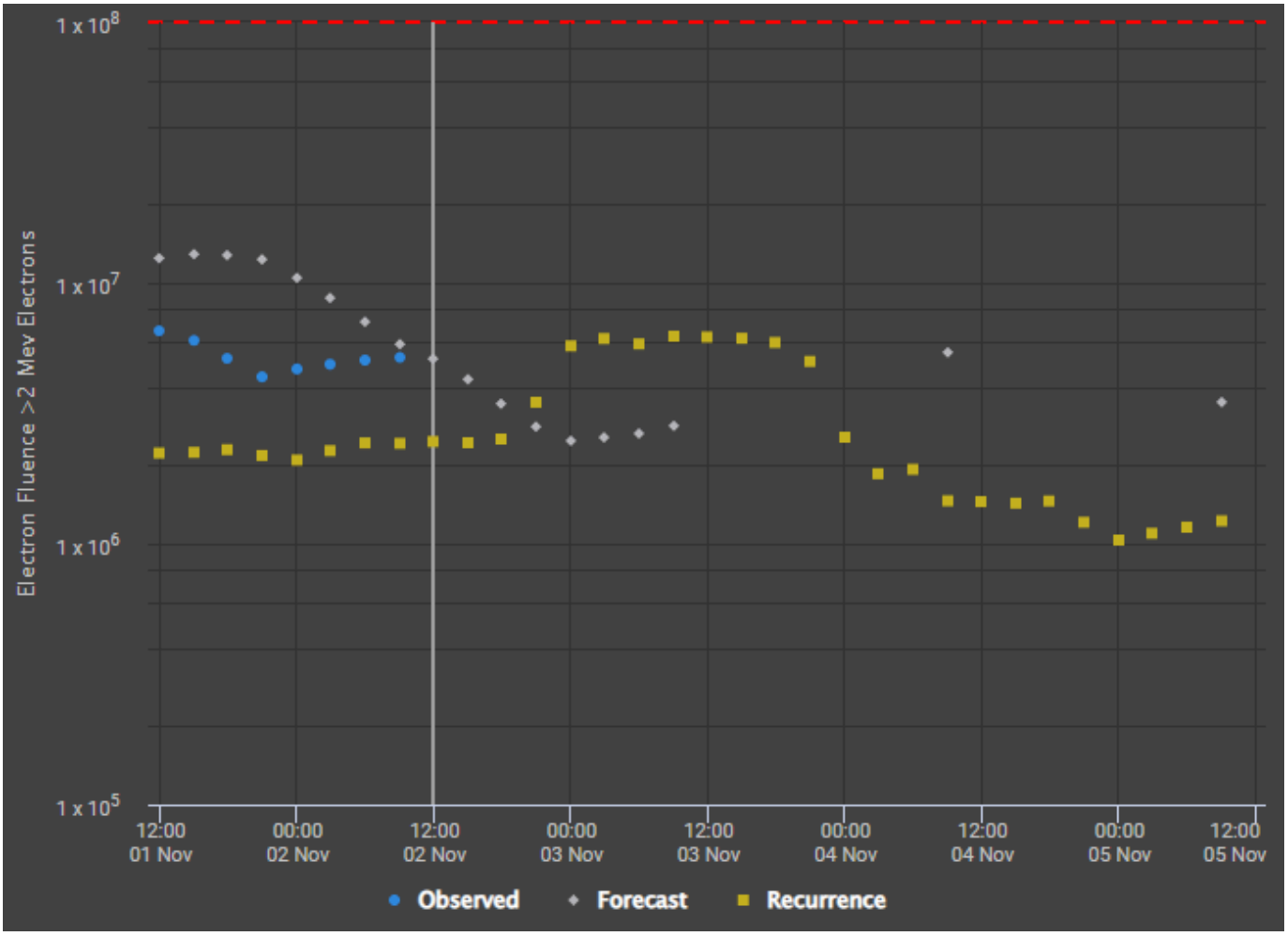
Figure 5: MOSWOC REFM model, considered a good guide currently.



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